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FIELD OF THE INVENTION

The invention concernes the space telescopes and large membraneous mirrors.

STATE OF THE FORMER ART

PERKINS and ROHRINGER (US 4 093 351), LE GRILL (Fr 2 662 512), and many other authors describe membranous mirrors tied to a peripheral rigid structure and stiffened and shaped by means of electric charges.

SILVERBERG, (WO 94/10721), describes a double flag membranous mirror, stiffened by surface charges, and shaped by outside fields created by a rigid support.

BUI-HAI et NHU (US 5 182 512) describes, for use in ultra hight frequency, a mirror obtained by curing a rotating resin.

LENINGRAD PREC MECH OPTI, (SU 1615 655 A) describes a monolithic mirror self shapable made up of two piezoelectric thin plates closely in contact on their whole surface, this mirror being curved overall by a single electrode acting on one of the plates, and locally by discrete electrodes acting on the other plate.

ANDREAS THEODORO AUGOUSTI (GB 2 247 323 A) describes a monolithic mirror self shapable made up of a deformable substrate covered on a face by a reflective surface and on the other face by a network of electrical conductors, the whole being located in a magnetic field with which the currents circulating in the conductors react.

In these two last mirrors the electrodes or conductors in contact with the reflective surface oblige to a high thickness and/or a high rigidity to minimize the surface defects induced by these electrodes or conductors generative of electric and thermal constraints.

None the preceding authors describes or evokes the folding of the mirrors.

SUMMARY OF THE INVENTION

PAGE 3/19 * RCVD AT 5/2/2009 2:38:53 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-6/38 * DNIS:2738300 * CSID:+33297611127 * DURATION (mm-ss):08-44

Space telescope comprising at least a membraneous mirror 1 and a actuating membrane 2 for shaping mirror 1.

Parabolic membranes. The membraneous mirror 1 and the actuating membrane 2, are made by spreading a liquid film 3 which hardens on the surface of a liquid 4 contained in a circular container 5 rotating around a vertical axis.

The mirror 1 and the actuating membrane 2 are tied together by means of their centrales flanges 2.1 or 2.2, either directly or by means of a cylinder 6.

Magnetic dipole. A magnetic dipole parallel to the optical axis is rigidly tied to the telescope.

If one electrode is implemented by a spiral shaped surface design, it works by electrostatic effect when no current flows, and by magnetic effect when a current is present.

BRIEF DESCRIPTION OF THE FIGURES

Fig. 1 – Mirror 1 and actuating membrane 2

Fig. 2, 3 – Membrane 2 on rotating liquid.

Fig. 4, 5 – Ring and handle for handling of the membrane 2.

Fig. 6 – Membrane with downward flanges.

Fig. 7 - Membrane with upward flanges.

Fig. 8, 9, 10 - Folding of the mirror.

DETAILED DESCRIPTION

Mirror and actuating membrane.

First preferred implementation (Fig. 2).

On takes a liquid 4 in an horizontal container 5 rotating smoothly around a vertical axis. Then, a small amount of another liquid 3 is poured over it all the way to the edge 5.1 of container 5.

This new liquid will wet the edge 5.1 and will solidify by spontaneous or induced curing thereby creating a membrane 2.

Second preferred implementation. It differs from the one before in that the liquid 3 contains a dissolved product which, after evaporation of the liquid 3, will leave a film onto the underlying liquid.

In a variant case, liquid 3 also contains suspended fibers.

Third preferred implementation (Fig. 2). In this case, the liquid 3 only contains suspended fibers which, after evaporation, will create a fibrous layer susceptible to receive a resin that can be cured.

A smoothing layer is superimposed on the composite layer so that the roughness of this composite layer does not showing at the surface of the smoothing layer, or be smaller as a pre set value.

Fourth preferred implementation. It differs from the first in that the liquid 3 is obtained by simultaneous or consecutive addition of two different liquids.

Fifth preferred implementation. Liquid 3 is absent, and the membrane 2 is created by a liquid or a gaz that solidifies directly onto the surface of the main liquid 4.

Reflecting layer. A reflecting medium is put on the membrane while it is still on the rotating liquid 4, namely by the stacking layers having appropriate dielectric indices and appropriate thicknesses.

Surface designs. While it is still on main liquid 4, the membrane 2 is locally covered, by means in accordance with the former art, with a conducting covering in the shape of surface designs 7, in so doing creating a number of annular electrodes centered on the optical axis, acting upon the radius of curvature, and a number of local electrodes acting upon local defects.

Electronic spread in the membrane. The membrane 2, while still on liquid 4, is locally covered, by means of the former art, with a thin structure identical to that of an integrated multilayer circuit having conducting, insulating or semi conducting elements, contiguous or superimposed.

Electrical supply of these surfaces designs is provided by surface conductors linked to a power supply through the center of the membrane.

These surface designs IC, when integrated to the actuating membrane of the mirror, allows, according to the invention, through the use of a capacitive coupling between the membrane and the mirror, a self control of the distance between mirror and membrane, and consequently the stabilization of the shape of the membranes without the intervention of the central system.

Actuating coils. Telescope is fitted at its bottom, at the level of the mirror, with a coil made of conducting elements.

The coil so created generates, when activated by an electric current, a magnetic field parallel to the axis of the telescope.

Discrete coils 7 of the actuating membrane will interact with this magnetic field, so as to maintain the desired shape of said

membrane and to keep it centered on the optical axis of the telescope.

The membrane 2 fitted with coils 7 has only an approximate shape, and the final shape is given to the mirror membrane 1 by the electrostatic forces existing between the conducting surface 8 of the mirror membrane and electrodes 9 present on membrane 2.

Mirror control. Surface electronic circuits integrated to the membrane during manufacturing, control the potentials of the electrodes acting upon the mirror, as well as the magnetic field of the membrane coils and the magnetic field of the telescope.

The metallised surface 8 of the mirror 1, or any conducting surface, should the reflective surface be dielectric, will initially be at 0 potential.

Electrodes 9 of actuating membrane 2 are set at positive or negative potentials, and as a result, decrease or increase the relative distance between mirror and actuating membrane.

In this manner, important local distorsion of the actuating membrane 2 will not prevent getting a perfect shape for the mirror.

Macro and micro controls. The system, according to claim, separates long range action acting on the actuating membrane through magnetic fields interacting with the field of the coil, and short range action acting through electric field between membranes.

Rotating container.

First preferred implementation (Fig. 4 and 5). The edge 5.1 of a circular rotating container 5 is surmounted and in contact with a ring 10 having handling means 11, such as handles allowing this ring to be grabbed and taken away from the edge.

The membrane 2 created when the film 3 solidifies, will stick the ring 10 thereby allowing this handling.

Second preferred implementation (Fig. 6). The outside wall 5.2 of the container is a surface of revolution.

The membrane 2 extends, by means of former art, with equal or greater thickness, on the outside wall 5.2 of the container, previously coated with a non sticking product, and in so doing creating a peripherical flange 2.3 that increases the stiffness of this periphery, thereby allowing it to recover better and faster its original shape.

It ends with a thicker band allowing handling.

In a variation (Fig. 7), the membrane extends on the inside wall of the container in the shape of a flange 2.4 higher than the rotating liquid.

Third preferred implementation (Fig. 6). The container 5 has a central circular hole 5.3 limited by a wall 5.4 holding the liquid.

The external surface 5.5 of wall 5.4 (facing the axis) has the shape of a cylindrical or conical surface of revolution.

The membrane 2 is extended, with increased thickness, on the external surface 5.5, in so doing creating an annular central flange 2.1.

Fourth preferred implementation. In a variation, the membrane is extended, by a flange 2.2, in the inside surface of the wall of the container and therefore raised above the rotating liquid.

Two examples of arrengement (fig. 43) show parallel membranes and back to back membranes.

Mirror and membrane folding (Fig. 8, 9, 10). The mirror 1 and the actuating membrane 2 are made totally or in part of a material with shape memory.

After manufacturing, the mirror 1 and the membrane 2 are distorted in such a way that this distorsion is retained until new conditions appear, that brings back the initial shape.

The membranes are concave; if one pushes (Fig. 8) the bottom of the concavity, at its center and perpendicularly to the tangent plane, it results a symmetrical circular distorsion which will intrude into the concavity.

Examination of this previously concave surface then reveals a concave peripheral ring and a central convex surface.

This central convex surface is equally pushed in the same conditions as before, and a new element of concave centered surface can be seen.

Pursuing with the creation of alternately concave and convex surfaces, one obtains a surface resembling a series of circular, centered waves (Fig. 8, 9, 10).

The thickness of this folding can be small as one wishes. It only requires an increase in the number of waves.

Once these waves fixed according to proper physical conditions, the almost flat object so obtained can be scrolled lengthwise.